



Technical Specifications

Installation & Maintenance Manual



cardinal

30 - 40 - 50 - 60 - 80 - 100 - 120
INDIRECT FIRED WATER HEATER

WARNING

This document is intended to be used by a factory trained and qualified heating contractor or service technician only. Read all Instructions within this document and within the relevant Boiler Installation and Maintenance Manual before proceeding. It is recommended to follow the procedures in the steps given. Skipping or missing procedural steps could result in substantial property damage, serious injury, or death.

CAUTION

- The heat transfer medium must be water or other nontoxic fluid having a toxicity rating or class of 1, as listed in Clinical Toxicology of Commercial Products, 5th edition.
- The pressure of the heat transfer medium must be limited to a maximum of 30 psig [2 bar] by an approved safety or relief valve.

NOTICE

- When receiving the CARDINAL unit, any claims for damage or shortage in shipment must be filed immediately against the transportation company by the consignee.
- Customer must register unit within sixty (60) days of installation in order to gain warranty coverage. See Warranty Card for details.
- Leave all documentation received with appliance with the owner for future reference.
- Installation and service should only be performed by a qualified installer or service technician.
- Installations and service should be performed by a licensed plumber or gas fitter in the Commonwealth of Massachusetts.



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PRODUCT AND SAFETY INFORMATION

IMPORTANT SAFETY INFORMATION FOR THE HOMEOWNER AND THE INSTALLER

This manual contains important information for the installation, starting up and maintenance of the appliance.

This manual must be provided to the Homeowner, who will keep it in a safe place for future reference.

Triangle Tube accepts no liability for any damage, injury, or loss of life resulting from incorrect installation, alteration of any factory supplied parts, or the use of parts or fittings not specified by Triangle Tube. If there is a conflict or doubt about the proper installation of the unit or any factory supplied replacement parts please contact Triangle Tube Technical Support.

DEFINITIONS

The following terms are used throughout this manual to bring attention to the presence of potential hazards or to important information concerning the product.

⚠ DANGER

Indicates the presence of a hazardous situation which, if ignored, will result in substantial property damage, serious injury, or death.

⚠ WARNING

Indicates a potentially hazardous situation which, if ignored, can result in substantial property damage, serious injury, or death.

CAUTION

Indicates a potentially hazardous situation which, if ignored, can result in minor property damage, or injury.

NOTICE

Indicates special instructions on installation, operation or maintenance, which are important to the equipment but not related to personal injury hazards.

BEST PRACTICE

Indicates recommendations made by Triangle Tube for the installers, which will help to ensure optimum operation and longevity of the equipment.

⚠ DANGER

Hot Water Can Scald!

- Water temperatures over 125 °F [51 °C] can cause severe burns instantly or death from scalding.



Water Temp.	Time for 3rd degree burn to occur
104 °F [40 °C]	Safe for bathing
120 °F [49 °C]	5 minutes
125 °F [51 °C]	2 minutes
130 °F [55 °C]	10 seconds
140 °F [60 °C]	3 seconds
148 °F [65 °C]	2 seconds
155 °F [68 °C]	1 second

- Children, disabled and elderly are at highest risk of being scalded.
- Never leave them unattended in or near shower, bathtub or sink.
- Never allow small children to use a hot water faucet or draw their own bath.
- If anyone using hot water in the building fits the above description or if local codes or state laws require specific water temperatures at hot water faucet, it is recommended:
 - To install a thermostatic mixing valve at this appliance or at each water faucet.
- or
- To set the thermostat knob for the lowest temperature which satisfies your hot water needs.
- Water drained from the system drain valves may be extremely hot. To avoid injury:
 - Make sure all connections are tight.
 - Direct water flow away from any person.

⚠ WARNING

Bacteria can develop in the domestic water system if certain minimum water temperatures are not maintained. Failure to maintain at least 140 °F [60 °C] domestic hot water temperature (using the Antilegionella function of your boiler, if any) can result in bacteria development, which can result in serious injury, or death.

PRODUCT AND SAFETY INFORMATION

CAUTION

- It is prohibited to carry out any modifications to the appliance without prior written consent from Triangle Tube.
- Faulty parts must only be replaced by genuine Triangle Tube factory parts.
- Failure to comply with these instructions can result in minor property damage, or injury.

CAUTION

- Protection must be taken against excessive temperature and pressure! Installation of the Temperature & Pressure (T&P) relief valve, supplied from the factory with the appliance, is required.
- Failure to comply with these instructions can result in minor property damage, or injury.

NOTICE

- *In case of any concern, please call your qualified service technician.*
- *Make sure to reference the unit's model number and serial number from the rating label when inquiring about service or troubleshooting.*
- *Triangle Tube reserves the right to change the technical characteristics, components and features of its products without prior notice. Check for an updated version of this manual at www.triangletube.com.*



1.1. Codes Compliance

Water heater installation must conform with the instructions in this manual and where applicable:

- local, state, provincial, and national codes, laws, regulations and ordinances.
- in Canada - CAN / CGA B149.1 or B149.2 Installation Code.

The Triangle Tube CARDINAL indirect-fired water heaters are exempt from the scope of ASME Section VIII, Division 1. An indirect-fired water heater's input is, by definition, the amount of heat that can be transferred to the tank. This heat transfer is determined by size and capacity of the tank's heat exchanger.

This is supported by ASME's interpretation VIII-1-86-136, dated May 22, 1987, which specifically states that an indirect-fired water heater with a heat exchanger capacity of less than 200 000 BTU/h [58.6 kW] is not considered within the scope of Section VIII, Division 1, even when its heat source is a heating boiler with an input above 200 000 BTU/h [58.6 kW].

NOTICE

CARDINAL Series water heaters will absorb less than 200 000 BTU/h [58.6 kW] when domestic water outlet temperature is 210 °F [99 °C] and boiler water supply temperature is 240 °F [115 °C]. Listed outputs are based on ASME Section VIII Interpretation VIII-1-86-136.

The CARDINAL water heater is for operation at outlet water temperature(s) not in excess of 180 °F [82 °C].

Where instructions in this manual differ from local, or national codes, the local or national codes take precedence.

1.2. Codes Restrictions

The single wall heat exchanger in the CARDINAL water heater complies with National Standard Plumbing Code, provided that:

- Boiler water (including additives) is practically non-toxic, having toxicity rating or class of 1, as listed in **Clinical Toxicology of Commercial Products, 5th Edition** and
- Boiler water pressure is limited to maximum 30 psig [2 bar] by approved relief valve.

Single wall heat exchangers are permitted under the Uniform Plumbing code - Paragraph L3.2. and L3.3 if they satisfy all of the following requirements.

1. The heat transfer medium is potable water or contains only substances which are recognized as safe by the U.S. Food and Drug Administration.
2. The pressure of the heat transfer medium is maintained less than the normal minimum operating pressure of the potable water system
3. The equipment is permanently labeled to indicate that only additives recognized as safe by the FDA shall be used in the heat transfer medium.

Other heat exchanger designs may be permitted where approved by the Administrative Authority.

1.3. Operating Restrictions

- Maximum domestic hot water temperature is 180 °F [82 °C] for commercial applications and 160 °F [71 °C] for residential applications.
- Maximum boiler water temperature is 210 °F [99 °C].
- Maximum working pressure for tank (domestic water) is 150 psig [10 bar].
- Maximum working pressure for the coil (boiler water) is 30 psig [2 bar].
- Water quality limitations (based on E.P.A National Secondary Drinking Water Regulations). See *Table 2 on page 3*.

BEST PRACTICE

In hard water areas (more than 7 grains of hardness) use a water softener on the cold domestic supply water to the appliance to prevent scaling.

NOTICE

- *Any water conditioning system for potable domestic water must be installed and maintained in accordance with manufacturer's specifications.*
- *Do not install the water heater on any application if the boiler piping contains non-oxygen barrier tubing or if the boiler piping is considered an "open system". Exposing the tank of the water heater to oxygen contamination will lead to premature tank failure and denial of the warranty.*

NOTICE

- *Artificially softened boiler/heating water from a salt based water softener is not allowed on the heating side of the water heater*
- *Distilled or RO water is not allowed on the heating side of the water heater*

Table 1 - Boiler/Heating Water Quality

Boiler water hardness	Less than 7 grains/gallon
pH level	Between 6.0 and 8.0
Chlorine	Less than 120 ppm (mg/l)
Chlorides	Less than 150 ppm (mg/L)
Conductivity	100 to 300 µS/cm
TDS (Total Dissolved Solids)	50 to 300 ppm (mg/L)
Molybdate Corrosion Inhibitor	100 to 300 ppm
Glycol	50% maximum inhibited propylene glycol only non-toxic

The CARDINAL Tank Indirect Water Heater requires both the closed loop boiler heating water and the open loop domestic water to meet certain criteria to ensure the safe and reliable operation of the unit and to maintain the warranty. The guidelines laid out below must be followed for all installations of the CARDINAL Tank Indirect Water Heater.

NOTICE

Failure to follow the instructions contained in this section will void the Triangle Tube Warranty.

CHAPTER 1 - PRE-INSTALLATION

1.4. Potable DHW Water Quality Requirements

The domestic water supplied to the water heater must be potable water that is free from contaminants, sediment, corrosive chemicals, and debris. It is the responsibility of the installer to ensure the water meets all the guidelines laid out in this manual. Water quality that exceeds the guidelines and results in damage or failure of the indirect tank is not covered by warranty.

If the domestic potable water quality is not within the allowable levels laid out in the document the water must be treated. Special attention should be taken in regard to sediment, hard water, pH, and chlorides.

- If sediment in the water supply is 5 microns or greater, a water sediment filter must be used.
- If there is hard water, a water softening system should be used.
- If the chlorides or pH are out of range, a water treatment company should be consulted to correct all water quality issues. Any water treatment/conditioning system must be installed and maintained in accordance with the manufacturer's specifications.

Table 2- Drinking Water Quality

Chloride	less than 150 ppm or mg/l
pH value	min. 6, max. 8
Total hardness	3 - 7 grains/gallon or 50-120 ppm or mg/l.
Total Dissolved Solids (TDS)	less than 120 ppm or mg/l.
Iron	less than 0.3 ppm or mg/l.
Aluminum	less than 0.2 ppm or mg/l.
Copper	less than 1 ppm or mg/l.
Manganese	less than 0.05 ppm or mg/l.
Zinc	less than 5 ppm or mg/l.
Dissolved Carbon Dioxide (CO ₂)	less than 15 ppm (mg/l.)
Sulfate	less than 250 ppm (mg/l.)
Corrosivity	Non-corrosive
Fluoride	less than 2 ppm (mg/l.)
Foaming agents	less than 0.5 ppm (mg/l.)

1.5. Closed Loop Boiler Heating Water Quality Requirements

CAUTION

To maintain efficient operation of the heat exchanger in the CARDINAL Tank the following instructions must be followed. Failure to follow these instructions will result in poor operation of the appliance, lead to potential failure of the product, and will void the warranty.

During installation and during the annual maintenance, the water quality must be checked and if found outside of the requirements, must be corrected.

A micro bubble air elimination device is required to be installed in all heating systems. An air scoop or an automatic air vent are not an acceptable substitute for a micro bubble air elimination device and may not be used as a substitute in the installation. A few examples of acceptable devices are:

- Taco 4900 Series
- Caleffi Discal
- Spirovent

If an automatic feed valve is installed in the heating system, it may not be left open indefinitely. A continuous feed of fresh water could damage the system. It is required that after a short period of time, between one to four weeks following the installation of CARDINAL Tank Indirect water heater into a heating system, the automatic feed valve be closed and the water quality be checked.

Plastic tubing such as PEX might be used in a heating system for piping or underfloor radiant heat. If oxygen permeable tubing is used in the heating system with the CARDINAL Tank, it must be separated from the rest of the heating system with a heat exchanger. Only oxygen barrier tubing can be used in the heating system side of a CARDINAL Tank indirect water heater.

1.6. Glycol

Boiler water (including additives) must be practically non-toxic, having toxicity rating or class of 1, as listed in Clinical Toxicology of Commercial Products, 5th Edition. A maximum 50/50 mixture of inhibited propylene glycol is allowed. Less than a 20% concentration of glycol is not permitted. Glycol will acidify because of thermal degradation overtime and could cause damage to components in the heating system.

This degradation is why heating system specific propylene glycol only must be used, these glycols contain additives and inhibitors or are meant to work with specific system inhibitors. The service technician must follow the antifreeze manufacturer's instruction. Antifreeze at a minimum must be checked on an annual basis or what is specified by the manufacturer of the antifreeze. Antifreeze must be replaced at a minimum every 3-5 years or what is specified by the manufacturer of the antifreeze.

When using antifreeze in the heating system circulator sizing must be considered because of the increase viscosity of the glycol mixture, a higher head circulator may be required. The glycol will also lower the heat capacity and the BTU output will be reduced by approximately 16-20% when using a mixture of 50% propylene glycol and 50% water. The reduced heating capacity at a 50/50 mixture will vary depending on the brand and makeup of the glycol. Glycol will reduce the efficiency and output of the indirect water heater because of this.

When adding other additives to the heating system glycol water mixture make sure they are compatible with the brand of glycol that is being used. Not all glycol and additives are compatible.

DANGER

Do not use automotive, ethylene glycol or petroleum-based antifreeze. Do not use any undiluted antifreeze. This can cause substantial property damage, serious injury, or death.

1.7. Locating Water Heater

- This water heater is not intended for outdoor installations.
- Keep distance between boiler and water heater to a minimum to:
 - Reduce piping heat loss
 - Provide minimal friction loss
- A water heater should always be located in an area with a floor drain.
- Locate water heater so that any leakage from the tank or water connections will not cause damage to the area adjoining the water heater or to lower floors in the structure.
 - When such a location is unavoidable, a suitable drain pan with adequate drainage, should be placed under the water heater.
- The CARDINAL Series Water Heaters are designed for vertical installation only.

1.8. Recommended Clearances

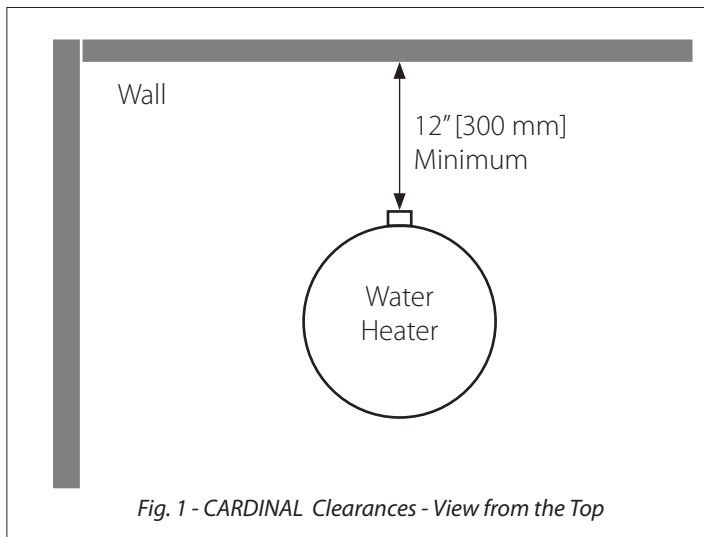
Water heater should be installed to allow adequate clearance for servicing.

Zero clearance is permissible to any side of the CARDINAL Series water heater that has no connection, but information labels must be visible for inspection.

The clearance required for any accessory or fitting that will be installed on either the heating and/or domestic circuits must be taken into account.

BEST PRACTICE

- *Recommended top or vertical clearance is 12" [300 mm] minimum.*
- *Refer to boiler manual for boiler clearances.*



2.1. Temperature & Pressure (T&P) Relief Valve

CAUTION

To reduce risk of excessive pressures and temperatures in the water heater, install temperature and pressure protective equipment required by local codes, but no less than a combination temperature and pressure relief valve certified by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment or materials, as meeting the requirements for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, ANSI Z21.22. This valve must be marked with a maximum working pressure of the water heater.

- Every CARDINAL water heater must be protected with a T&P relief valve.
 - Every CARDINAL Tank water heater is supplied with a combination temperature and pressure relief valve. See specifications in *Table 3 below*.
 - Always verify that the combination temperature and pressure relief valve supplied with the water heater complies with local codes.

Table 3 - T&P Valve Characteristics

	CARDINAL	
	30-40-50	60-80-100-120
Inlet thread	3/4" M NPT	
Probe length	8" [200 mm]	
CSA rating	105,000 BTU/hr	205,000 BTU/hr
Rating 75 Psi [5 bar]	—	1,034,000
Rating 100 Psi [7 bar]	—	1,327,00
Rating 125 Psi [8.6 bar]	500,000	1,619,000
Rating 150 Psi [10 bar]	500,000	1,912,000

2.1.1 Standard Installation

- Install T&P relief valve in the **Temperature and Pressure Relief Valve** connection on the top of the water heater (Refer to *Fig. 2 on page 9*).

2.1.2 Commonwealth of Massachusetts Installation

In the Commonwealth of Massachusetts and in all jurisdictions requiring a vacuum breaker to be installed on the domestic cold water inlet, follow these requirements:

- The water heater shall be protected against loss of water from siphoning due to loss of supply pressure by a vacuum relief valve installed in the cold water supply line at a level above the top of the heater or tank.
- The vacuum relief valve shall be in accordance with the Standard ANSI Z21.22 at the latest revision.
- Valves shall have minimum 1/2-inch diameter orifice and the air inlet opening on any vacuum valve shall not be smaller than the nominal pipe size of the valve
- Valves shall be sized to have a cross sectional area equal to a pipe, not less than one pipe diameter smaller than the tank supply or drain, whichever is larger.

2.1.3 T&P Relief Valve Discharge Piping

- **T&P relief valve discharge piping must be:**
 - Made of material serviceable for temperatures of 250 °F [120 °C] or greater.
 - Directed so that hot water flows away from all persons.
 - Directed to a suitable place for disposal.
 - Installed so as to allow complete draining of the T&P relief valve and discharge line.
 - fitted with a discharge piping, within 6" (150 mm) of the floor
- **T&P relief valve discharge piping must not be:**
 - Excessively long. Using more than 2 elbows or 15 feet (4.5 m) of piping can reduce discharge capacity.
 - Directly connected to a drain. Terminate discharge piping within 6" (150 mm) from drain. Refer to local codes.
 - Plugged, reduced, blocked, capped, threaded, or restricted .
 - Subject to freezing.

⚠ WARNING

Do not install any valve between T&P relief valve and tank connection or on T&P relief valve discharge piping. Do not plug T&P relief valve or discharge piping. Improper placement and piping of T&P relief valve can cause substantial property damage, serious injury, or death.

2.2. Drain Valve

A drain valve is supplied with the unit (draining of the domestic tank). For information on draining the tank, see *page 18*.

2.2.1 Standard Installation

- Install drain valve on drain connection (Refer to *Fig. 2 on page 9*).
- Pipe the drain piping with drain valve from the tee connection to:
 - a suitable place for disposal
 - or
 - terminate within 12" [300 mm] of the floor.

2.3. Thermal Expansion

If a backflow preventer, check valve or pressure reducing valve is piped on cold water supply piping of water heater, install a potable water expansion tank on cold water supply line to prevent normal thermal expansion from repeatedly forcing open T&P relief valve.

CAUTION

T&P relief valve is not intended for constant duty, such as relief of pressure due to repeated normal system expansion. Correct this condition by installing a properly sized expansion tank in domestic water system.

Refer to expansion tank manufacturer's installation instructions for proper sizing.

2.4. Water Hammer

Dishwashers, clothes washers and fast-closing positive shut-off valves incorporated in the system all contribute to creating water shock. Install a water hammer arrester to prevent damage to pipes and appliances. See device manufacturer's instructions for application and installation.

NOTICE

Water hammering within the domestic piping system can cause premature failure of the tank. This type of failure is NOT covered under warranty.

2.5. Vacuum Breaker

Installing a vacuum breaker (Watts N36-M1 or equivalent) on the domestic cold water inlet will prevent damage to the tank if a negative pressure is developed in the domestic supply line. See manufacturer's instructions for application and installation of the vacuum breaker.

2.6. General Piping

- For domestic water piping diagram, refer to *Fig. 2 on page 9 and Fig. 3 on page 9*.
- For Boiler water piping, refer to *Fig. 6 on page 11 thru Fig. 9 on page 12*.
- For Multiple water heater domestic and boiler piping, refer to *Fig. 4 on page 10 and Fig. 5 on page 10*, and *Fig. 10 on page 13 and Fig. 11 on page 13*.
- See *Table 4 on page 7* for domestic and boiler piping connection sizes.
- All plumbing must meet or exceed all local, state and national plumbing codes.
- Use pipe dope or tape suitable for potable water systems.
- Use isolation valves to isolate system components.

2.7. Domestic Piping

- Union on domestic hot water outlet should be piped at a higher elevation than domestic water drain valve. This will make draining the water heater easier.
- Install unions for easy removal of water heater. It is recommended to use dielectric unions or couplings to protect hot and cold water fittings from corrosion when connecting dissimilar materials such as copper and galvanized iron pipe.
- If copper pipe is used for domestic water connections, first solder or press pipe to a threaded adapter and then screw adapter into cold water inlet on top of water heater. Inlet connection contains an internal plastic dip tube which can be damaged by heat from soldering.

NOTICE

Do not apply heat to the cold water inlet when making sweat connections to water heater. Sweat tubing to adapter before fitting adapter to cold water inlet of heater. It is imperative that no heat be applied to the cold water inlet, as it contains a non metallic dip tube.

CHAPTER 2 - INSTALLATION - PIPING

- When the water supply pressure is higher than 70 psig [4.5 bar], it is recommended to install a pressure reducing valve on cold water supply line to prevent water loss through T&P relief valve.
- If the water heater will replace a tankless coil in the boiler, disconnect the piping to coil and allow the water to drain from coil. Do not plug the tankless coil.



Plugging tankless coil inlet and outlet will result in substantial property damage, serious injury, or death.

2.8. Thermostatic Mixing Valve

- It is recommended to install an optional mixing valve on the domestic hot water outlet.
- Mixing valve must comply with ASSE 1017

2.9. Recirculation Piping

- A stainless steel or bronze circulator is required on potable water systems.
- Install automatic mixing valve either at the hot water outlet of water heater or each hot water faucet.

2.10. Multiple Water Heater Systems

- Parallel Pipe Recirculation Systems - Manifold recirculation return to all water heaters.
- Install an automatic mixing valve either at the hot water outlet of water heater or each hot water faucet.



Failure to install automatic mixing valve where recommended will result in serious injury, or death.

Table 4 - Piping dimensions

Water Heater Model	Connections (inches)			Minimum Boiler Piping* Diameter (Inches)
	Domestic Water Inlet/Outlet (M - NPT)	Boiler Water Supply/ Return (F - NPT)	Temperature and Pressure Relief Valve Connection (F - NPT)	
CARDINAL 30	3/4	1	3/4	1
CARDINAL 40	3/4	1	3/4	1
CARDINAL 50	3/4	1	3/4	1
CARDINAL 60	3/4	1	3/4	1
CARDINAL 80	1	1	3/4	1
CARDINAL 100	1	1	3/4	1
CARDINAL 120	1	1	3/4	1

*recommended minimum boiler piping diameter is based on the installer correctly sizing the piping and pump to account for pressure drop as well as any glycol in the system.

2.11. Boiler Piping

- All PEX tubing used to connect the indirect tank water heater to the boiler must have an oxygen barrier.
- If PEX tubing is used for boiler water piping, it must have a maximum oxygen diffusion rate of 0.1 mg/liter-day for boiler and water heater protection.

NOTICE

The CARDINAL IDWH must be installed on a closed loop type hydronic system. Failure to provide such a system will result in premature failure of the tank and void the warranty.

- Boiler water (including additives) must be practically non-toxic, having toxicity rating or class of 1, as listed in **Clinical Toxicology of Commercial Products, 5th Edition**.
- If antifreeze is used in the boiler system, local codes may require a backflow preventer on cold water supply line. Use antifreeze specifically intended for hydronic heating systems. A maximum percentage of 50% is allowed for inhibited propylene glycol.

DANGER

Do not use automotive, ethylene glycol or petroleum-based antifreeze. Do not use any undiluted antifreeze. This can cause substantial property damage, serious injury, or death.

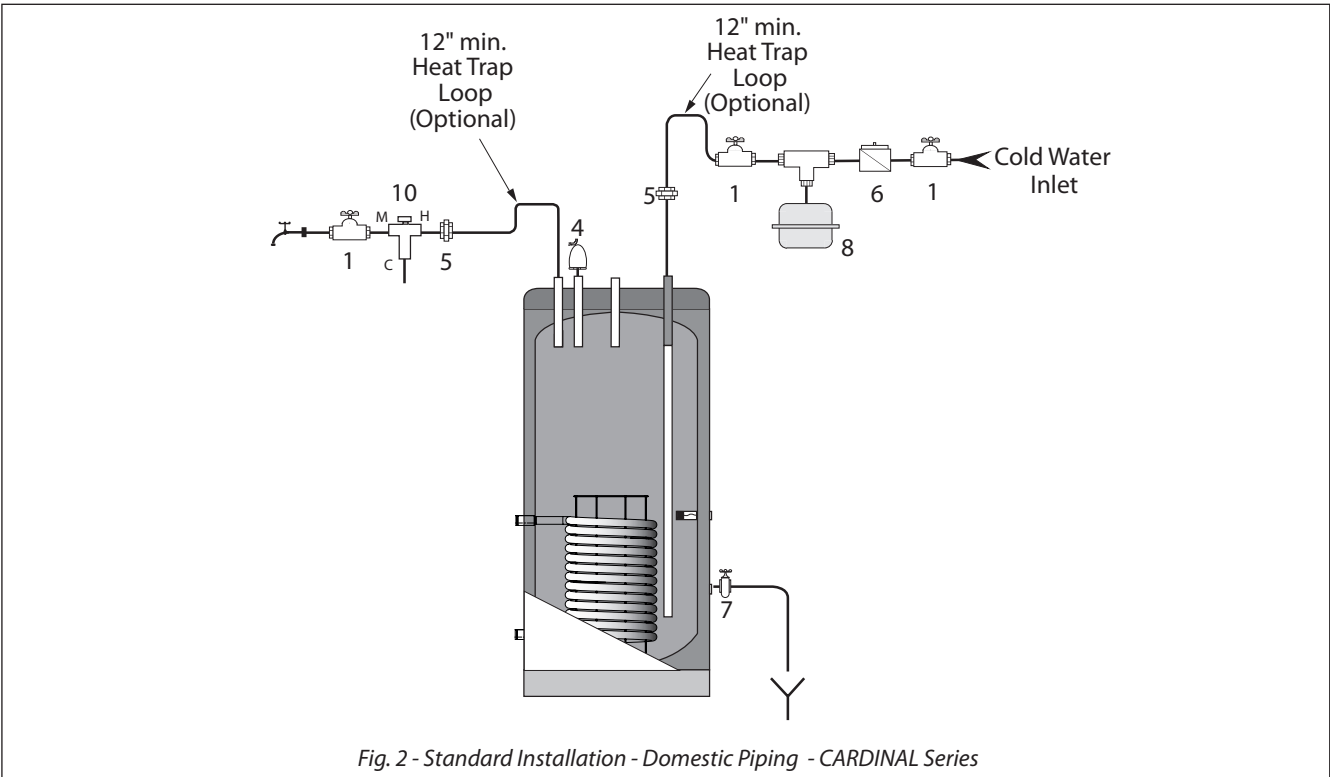


Fig. 2 - Standard Installation - Domestic Piping - CARDINAL Series

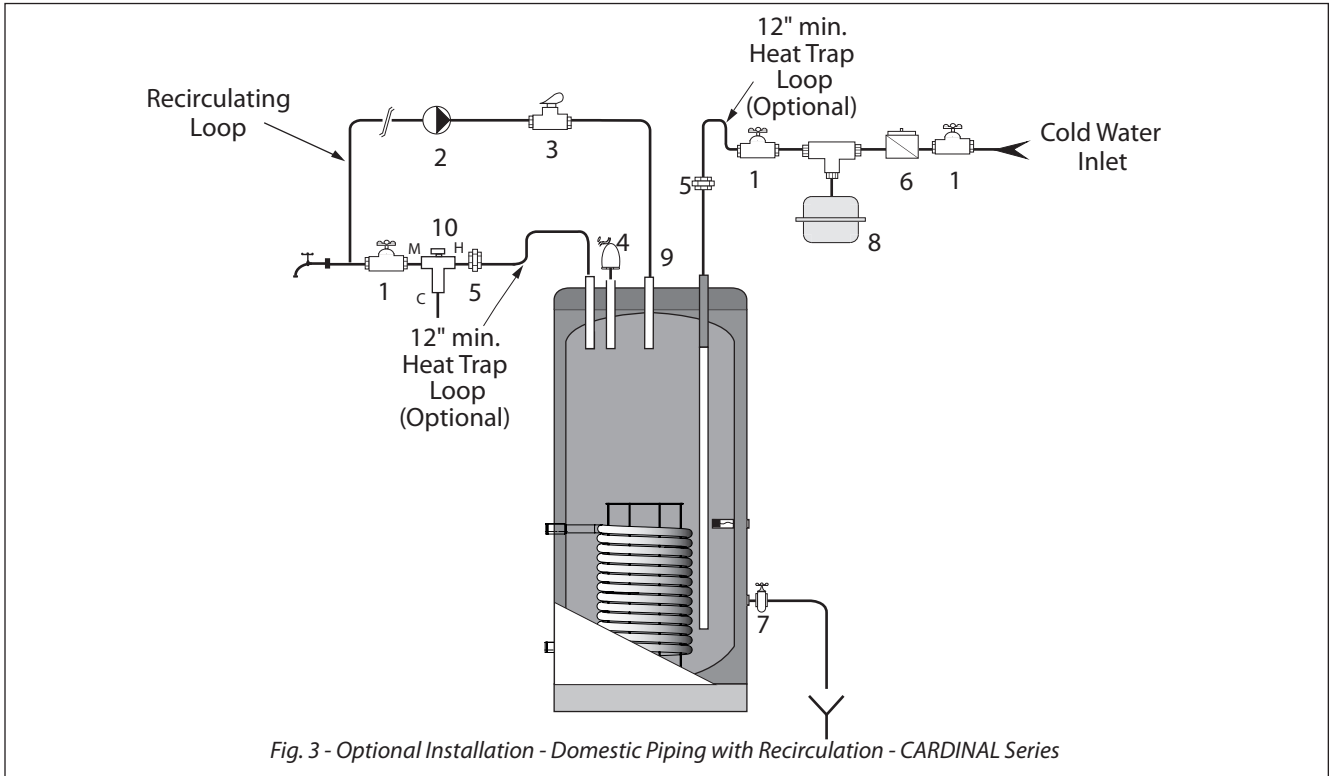


Fig. 3 - Optional Installation - Domestic Piping with Recirculation - CARDINAL Series

- | | |
|---|---|
| 1. Shut-off valve | 7. Drain valve |
| 2. Recirculation Circulator | 8. Thermal expansion tank (potable) |
| 3. Flow Check Valve | 9. Recirculation connection |
| 4. T&P relief valve | 10. Thermostatic mixing valve (*) |
| 5. Unions | (*) Recommended devices may be required by local codes. |
| 6. Backflow preventer or pressure reducing valve(*) | |

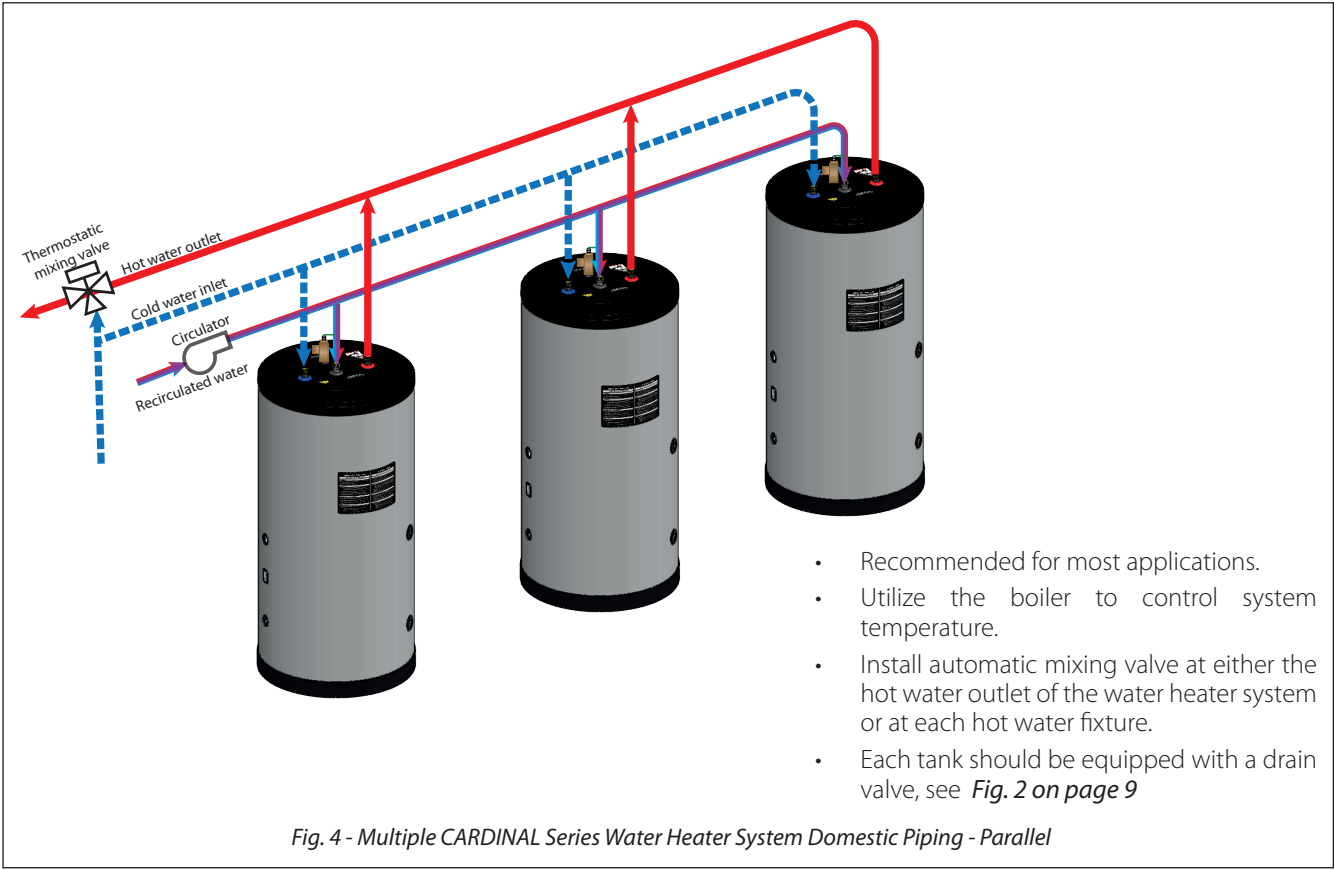


Fig. 4 - Multiple CARDINAL Series Water Heater System Domestic Piping - Parallel

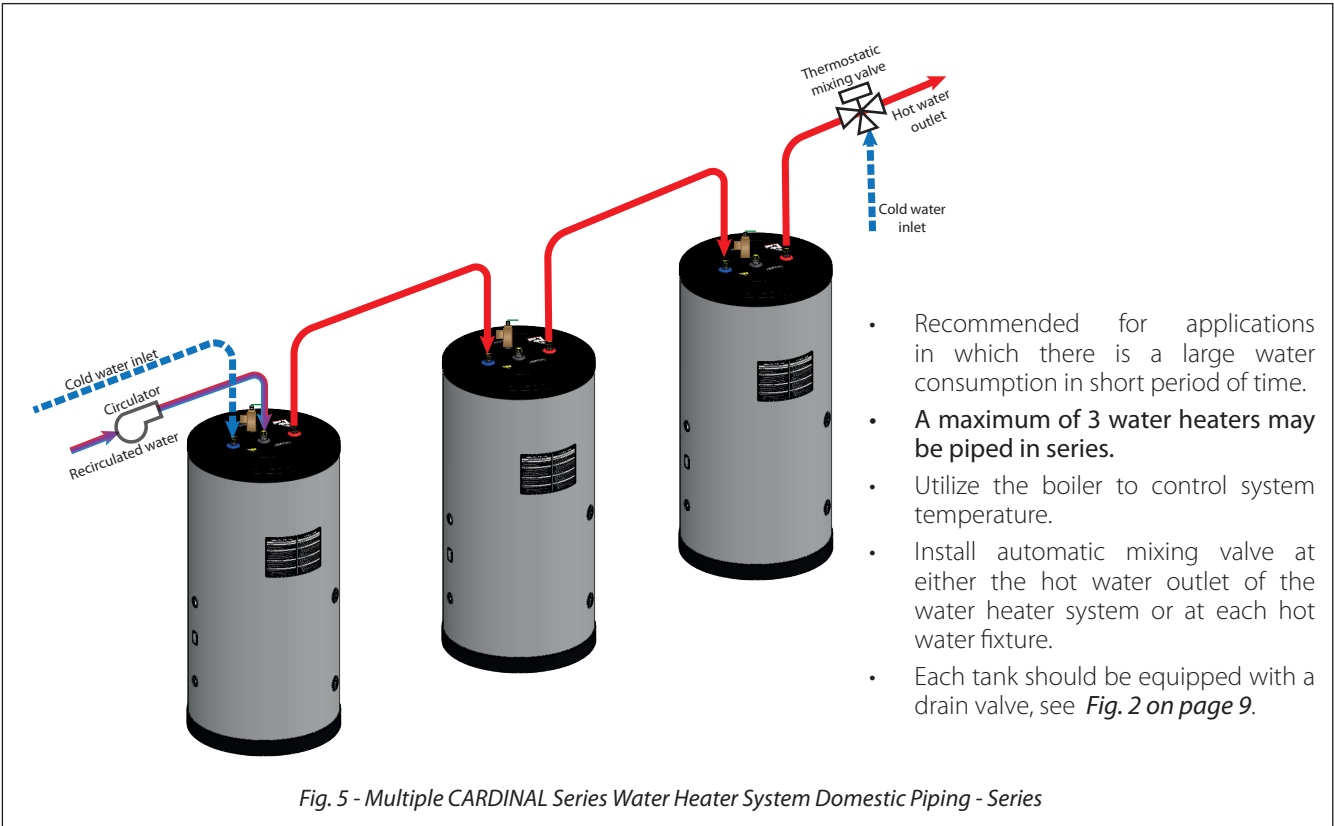


Fig. 5 - Multiple CARDINAL Series Water Heater System Domestic Piping - Series

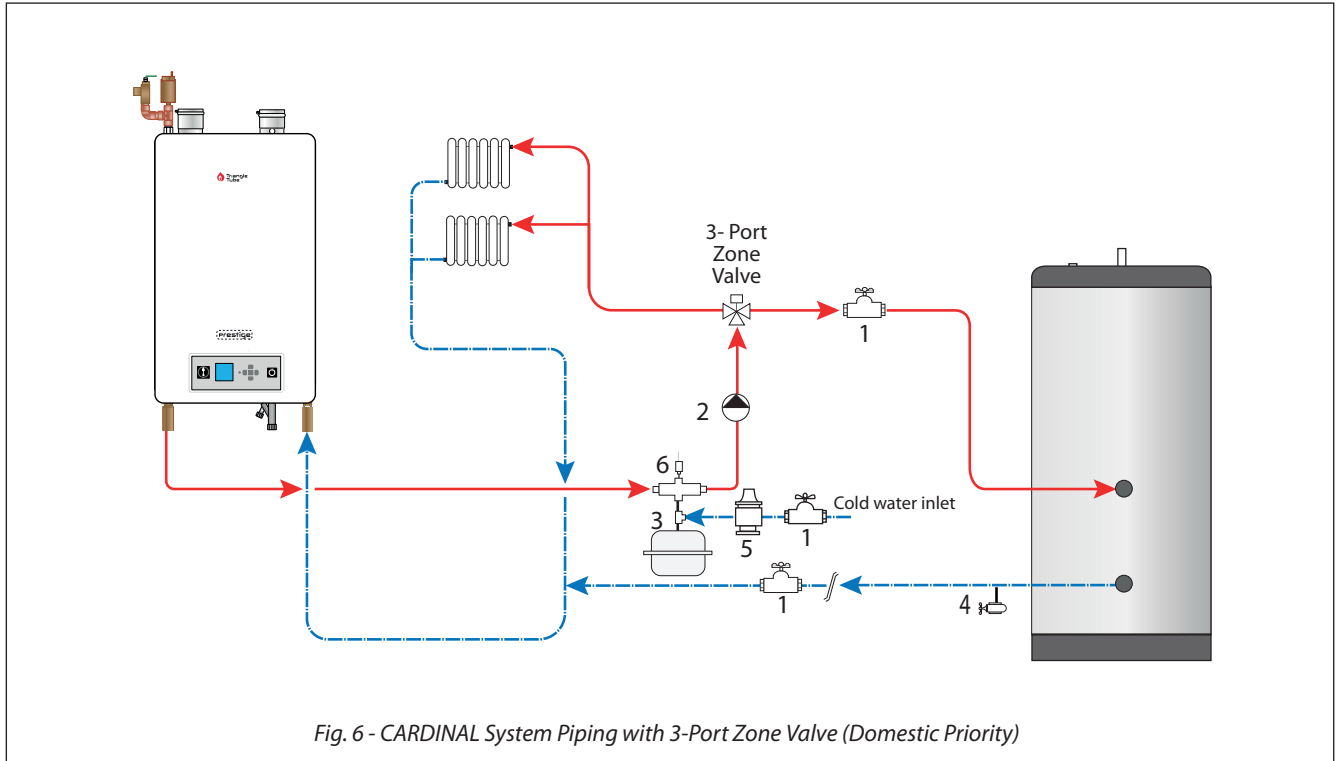


Fig. 6 - CARDINAL System Piping with 3-Port Zone Valve (Domestic Priority)

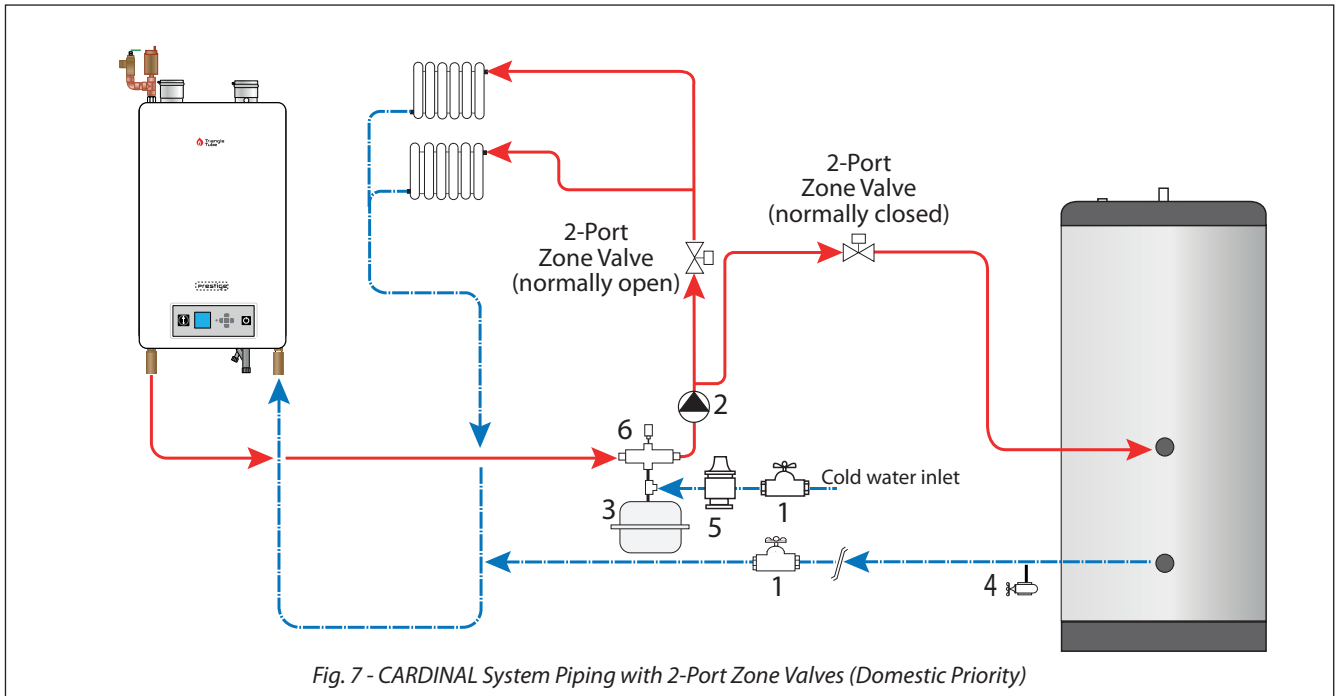
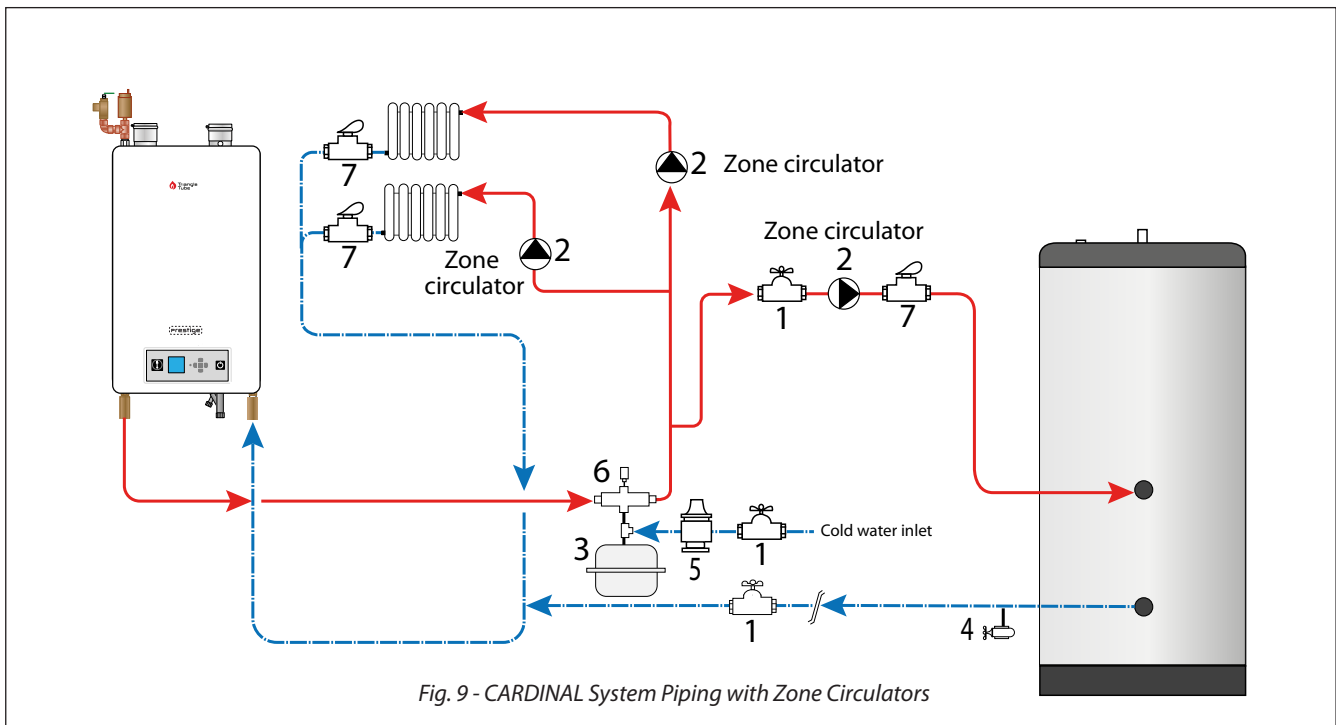
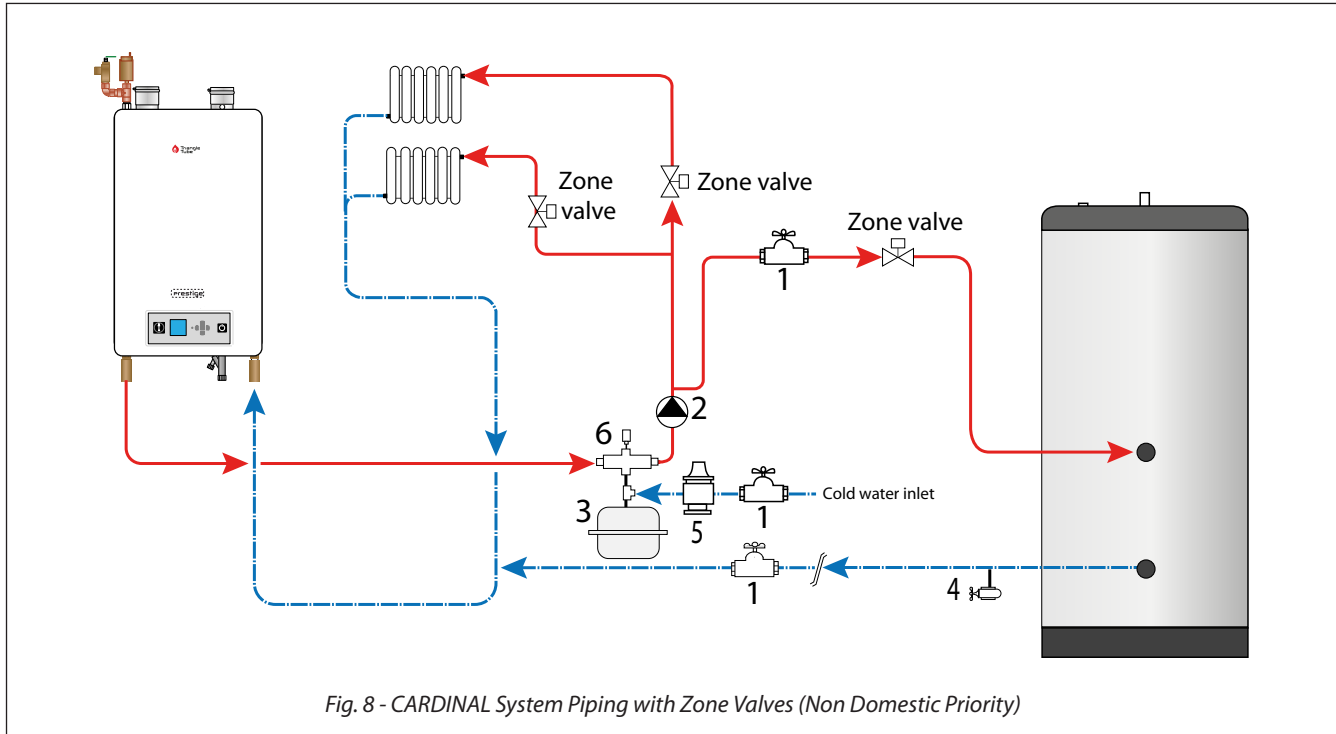
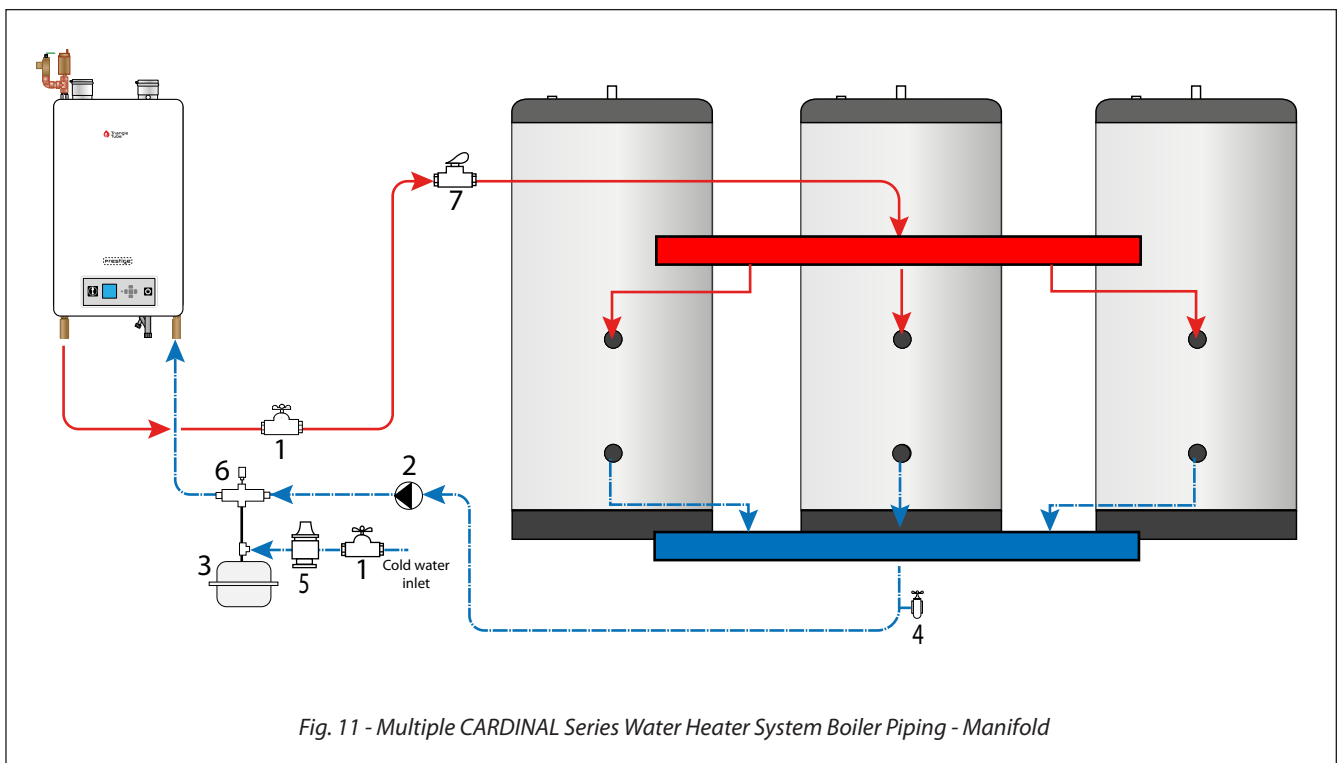
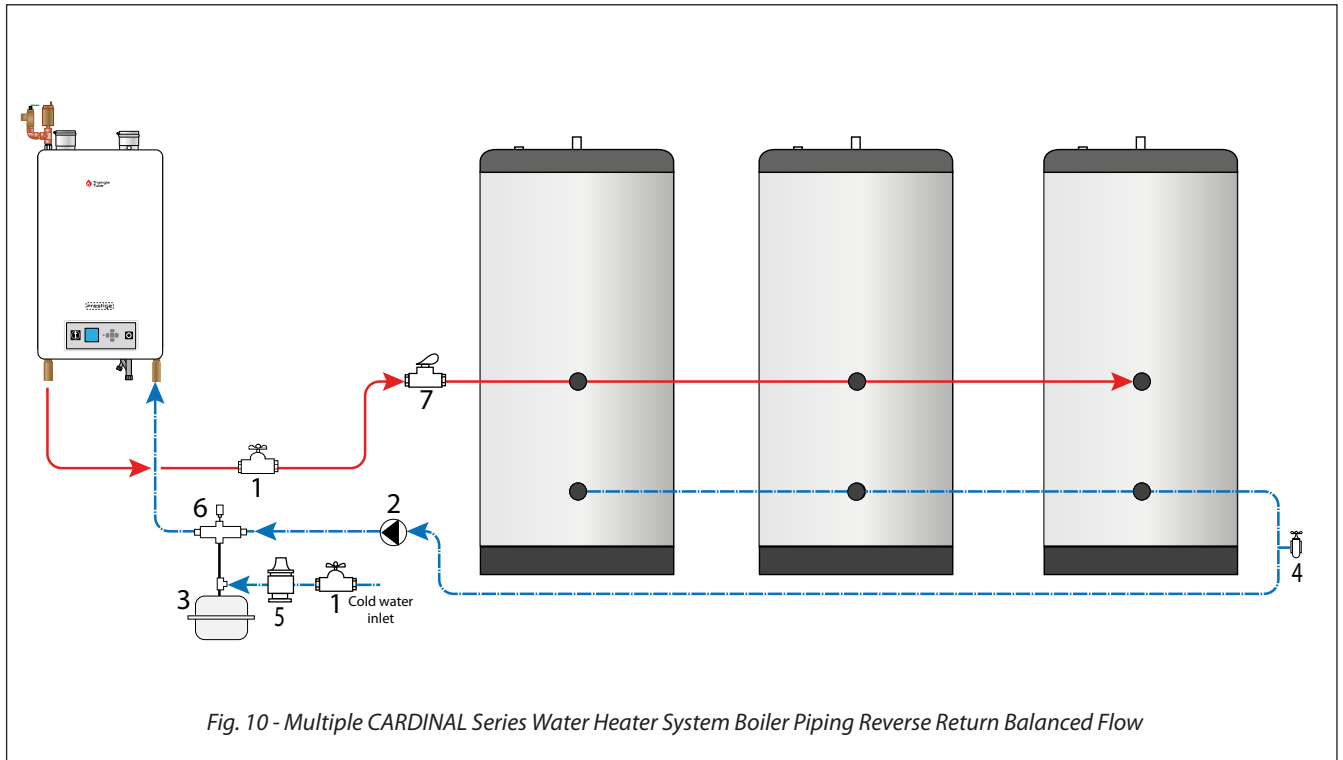


Fig. 7 - CARDINAL System Piping with 2-Port Zone Valves (Domestic Priority)

1. Shut-off valves
2. Circulator
3. Expansion tank
4. Drain valve
5. Feed valve
6. Air separator



- | | |
|--------------------|---------------------|
| 1. Shut-off valves | 6. Air separator |
| 2. Circulator | 7. Flow check valve |
| 3. Expansion tank | |
| 4. Drain valve | |
| 5. Feed valve | |



- | | |
|--------------------|---------------------|
| 1. Shut-off valves | 6. Air separator |
| 2. Circulator | 7. Flow check valve |
| 3. Expansion tank | |
| 4. Drain valve | |
| 5. Feed valve | |

CHAPTER 3 - INSTALLATION - WIRING

3.1. Temperature Sensor and Drywell

Prestige and Instinct boilers are equipped with a sensor that can be used with the tank.

A drywell is provided with the tank, to be installed in the designated location (refer to *Fig. 15 on page 22* for the exact location).

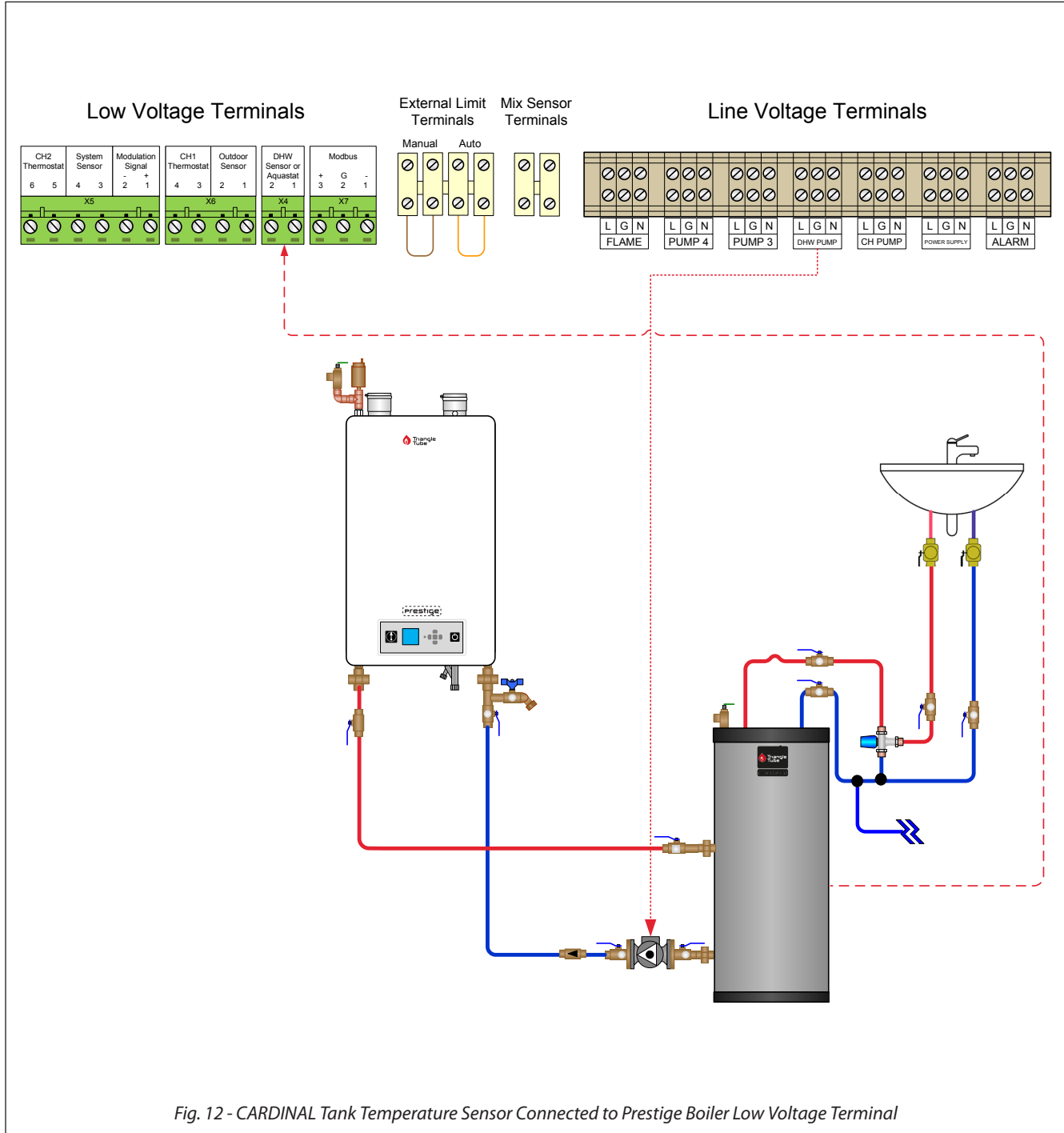
NOTICE

The drywell shall be installed using appropriate sealing material and tightened with a torque of 51 Lb.ft (70 Nm).

3.2. Thermostat (Aquastat)

The tank is delivered with an optional aquastat of the immersion type (**Resideo L4080B1352**), to be installed.

It is set at its lowest setting (100 °F [37.8°C]) at delivery.



CHAPTER 3 - INSTALLATION - WIRING

The thermostat should be set at 120 °F [49 °C] or lower.



Consumer Product Safety Commission and some states recommend temperatures settings of 120 °F [49 °C] or less. Setting thermostat higher than 120 °F [49 °C] will increase risk of scald injury and cause severe personal injury or death.

All wiring must be a minimum of 18 gauge or greater as required by the thermostat manufacturer and installed in accordance with:

- **U.S.A.** - National Electrical Code and any other national, state or local code requirements having jurisdiction.
- **Canada** - C.S.A. C22.1 Canadian Electrical Code Part 1 and any other national, provincial and local code.

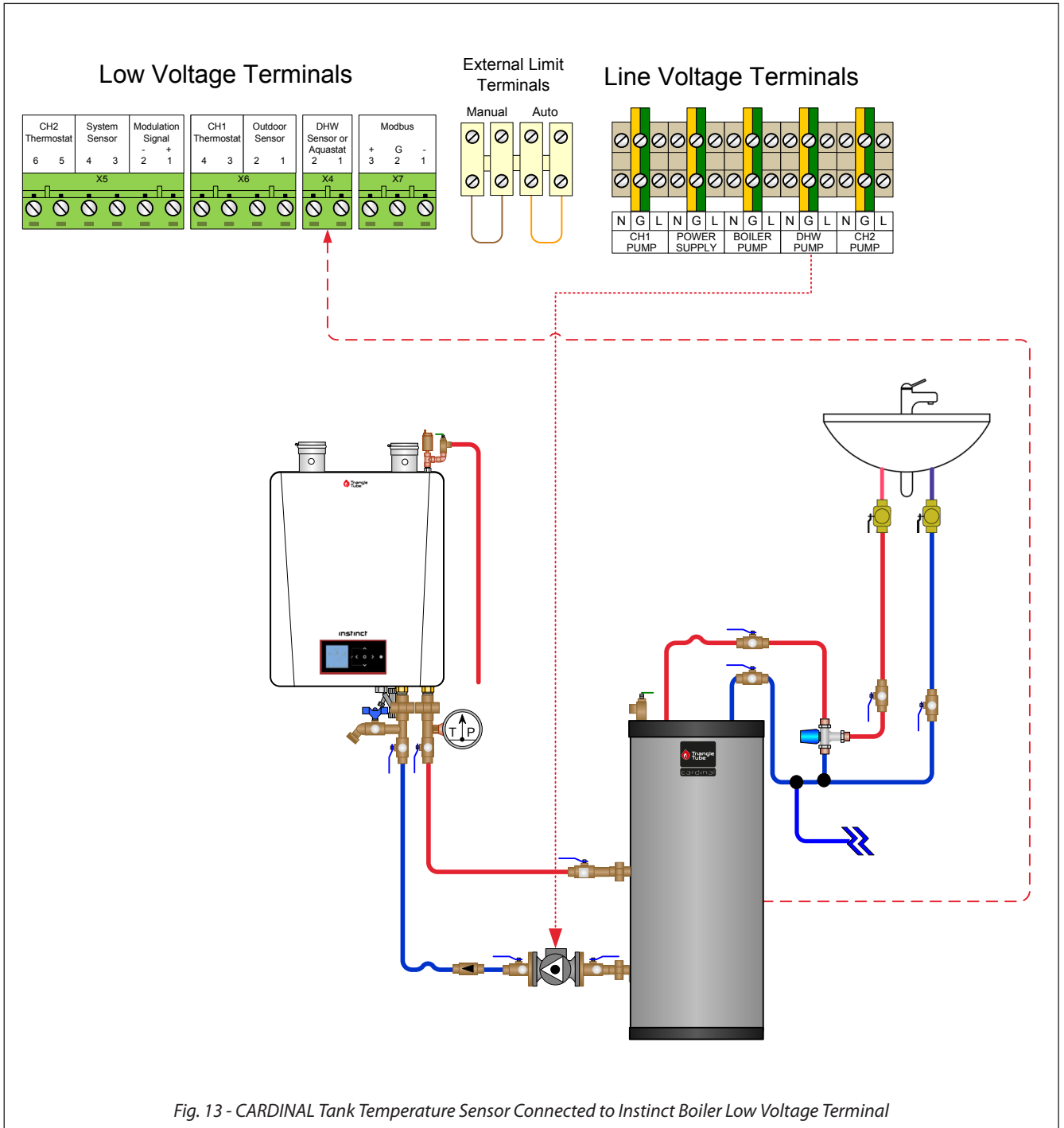


Fig. 13 - CARDINAL Tank Temperature Sensor Connected to Instinct Boiler Low Voltage Terminal

CHAPTER 4 - WATER HEATER START-UP

4.1. Filling the Coil (Boiler Water)

CAUTION

- Never use water heater unless coil and tank are completely filled with water.
 - Coil must be completely filled and pressurized before pressurizing the tank.
1. Close boiler water drain valve.
 2. Open boiler water isolation valves for water heater.
 3. Follow instructions furnished with boiler to fill with water.
 4. When coil is full, and air stops escaping, close the manual air vent (in the boiler piping loop).
 5. If antifreeze is used in boiler water, check concentration. Boiler water (including additives) must be practically non-toxic, having toxicity rating or class of 1, as listed in Clinical Toxicology of Commercial Products, 5th Edition.

WARNING

Do not use automotive, ethylene glycol or petroleum-based antifreeze. Do not use any undiluted antifreeze. This can cause substantial property damage, serious injury, or death.

4.2. Filling the Tank (Domestic Water)

CAUTION

- Never use water heater unless coil and tank are completely filled with water.
 - Coil must be completely filled and pressurized before pressurizing the tank.
1. Close drain valve at domestic water drain connection.
 2. Open water heater's domestic water isolation valves.
 3. Vent air from domestic tank by opening nearest hot water faucet. Fill domestic water tank completely by allowing water to run until there is a constant flow of water.
 4. Close hot water faucet.

DANGER

HOT WATER CAN SCALD!

Water temperature over 125 °F [51 °C] can cause severe burns instantly or death from scalds.



Water Temp.	Time for 3rd degree burn to occur
104 °F [40 °C]	Safe for bathing
120 °F [49 °C]	5 minutes
125 °F [51 °C]	2 minutes
130 °F [55 °C]	10 seconds
140 °F [60 °C]	3 seconds
148 °F [65 °C]	2 seconds
155 °F [68 °C]	1 second

- Feel water before bathing or showering.
- Consumer Product Safety Commission and some states recommend temperatures settings of 120 °F [49 °C] or less. Setting thermostat higher than 120 °F [49 °C] will increase risk of scald injury and cause severe personal injury or death.
- Water heated to a temperature suitable for clothes washing, dish washing and other sanitizing needs will scald and cause permanent injury.
- Children and elderly, infirm, or physically handicapped persons are more likely to be injured by hot water. Never leave them unattended in or near a bathtub. If anyone using hot water in the building fits this description, or if state laws or local codes require certain water temperatures at hot water faucets, take special precautions.
 - Install an automatic mixing valve at water heater or at each hot water faucet, bath and shower outlet. Selection and installation must comply with valve manufacturer's recommendation and instructions.
 - Use the lowest practical temperature setting.
 - Check water temperature after any adjustment.

WARNING

It is prohibited to set the boiler limit control above 180 °F [82 °C]. This can cause substantial property damage, serious injury, or death if ignored.

NOTICE

- *Household water usage patterns will affect water temperature at any faucet or shower. Occasionally check temperature at each point of use, then adjust thermostat accordingly. Always recheck temperature after adjusting thermostat.*
- *When hot water is used in repeated small quantities, a “stacking” effect can develop in the water heater. The upper layer of water in tank can be hotter than lower layer, resulting in very hot water coming out at the faucet.*
- *It is therefore recommended to either lower the temperature setting at boiler controller or install automatic mixing valves as indicated in these instructions in order to reduce water temperature levels. Consult your installer or service technician.*

4.3. Adjusting the Temperature

Temperature should be adjusted through the boiler controller when using the DHW sensor supplied with the Prestige or Instinct boilers.



Bacteria can develop in the domestic water system if certain minimum water temperatures are not maintained. Failure to maintain at least 140 °F [60 °C] domestic hot water temperature (using the Antilegionella function of your boiler, if any) can result in bacteria development, which can result in serious injury, or death.

- Check water temperature at a hot water faucet immediately after first heating cycle. Further temperature adjustment may be necessary as water heating system is used. Recheck water temperature at faucet after adjustment.

4.3.1 Adjusting the Temperature Using a Thermostat

A Resideo L4080B1352 thermostat (AquaStat) can be used to control the DHW temperature in the tank. It is provided with the tank as an optional accessory to be installed.

The provided aquastat controller has an adjustable setpoint, but is set to its lowest temperature position when shipped from the factory (100 °F [37.8 °C]).

The marking on the aquastat is the preferred starting point for setting the temperature control.

The AquaStat shall be installed by a trained, experienced technician, who will make sure to adjust the aquastat setpoint according to the requirements below.



There is a hot water scald potential if the thermostat is set too high. Setting the aquastat higher than the recommended temperature will increase risk of scald injury and cause severe personal injury or death

Valves for reducing point of use temperature by mixing cold and hot water are available. Consult a licensed plumber or the local plumbing authority.



For correct installation and operation of the aquastat, please read carefully the information provided with the aquastat. Failure to follow the instructions could damage the product or cause a hazardous condition.

The thermostat should be set at 120 °F [49 °C] or lower.



Consumer Product Safety Commission and some states recommend temperatures settings of 120 °F [49 °C] or less. Setting thermostat higher than 120 °F [49 °C] will increase risk of scald injury and cause severe personal injury or death.

When adjusting thermostat, be sure boiler limit control is set a minimum of 20 °F [5 °C] higher.

CHAPTER 5 - WATER HEATER MAINTENANCE

5.1. Maintenance Schedule

5.1.1 Annual service by qualified service technician should include the following:

- Any procedure required by local codes.
- Verify system pressure. Air venting procedure may require adding water to bring system up to pressure, typically 12 psig [0.8 bar].
- Manually operate T&P relief valve at least once a year. This will release some hot water.



WARNING

Before operating T&P relief valve, make sure no one is in front of or around T&P relief valve discharge piping. Hot discharge water can cause substantial property damage or serious injury.

- Move operating lever to open position for a few seconds and then move it back, allowing it to snap closed. After T&P relief valve is operated, if it continues to release water, close cold water inlet to water heater immediately. Follow draining instructions, to relieve pressure from the tank and replace T&P relief valve. If T&P relief valve weeps periodically, it may be due to thermal expansion see *"Thermal Expansion"* on page 6. Do not plug T&P relief valve or discharge piping.



DANGER

Plugging T&P relief valve or discharge piping can cause excessive pressure in water heater, resulting in substantial property damage, serious injury, or death.

- Follow instructions on circulator to oil it, if required.
- Check mixing valve, valves, pipes and fittings for leaks.
- Check function of field-installed controls and valves. See component manufacturer's instructions.
- Review homeowner's maintenance responsibilities and their frequencies, including any not listed in the following section.

5.1.2 Homeowner monthly maintenance to include:

- Check for air.
 - Manual air vent-open and close briefly to release any air.
- Check for leaks.
 - Visually check valves, pipes and fittings for leaks. Call qualified service technician to repair any leaks.

5.2. Filling Water Heater

See *"Filling the Coil (Boiler Water)"* on page 16 and *"Filling the Tank (Domestic Water)"* on page 16.

5.3. Draining Water Heater

Drain the water heater if it will be shut off and exposed to freezing temperatures. Freezing water will expand and damage water heater.

- If boiler water contains sufficient antifreeze, then only the domestic water needs to be drained.

CAUTION

Close the domestic water isolation valves, and relieve tank pressure before draining the domestic water from the tank.

- If boiler water does not contain sufficient antifreeze, then the boiler water and domestic water must be drained.

If antifreeze is used in boiler water, check concentration.

Boiler water (including additives) must be practically non-toxic, having toxicity rating or class of 1, as listed in *Clinical Toxicology of Commercial Products, 5th Edition*. A maximum 50/50 mixture of inhibited propylene glycol is allowed. Follow antifreeze manufacturer's instruction.

Antifreeze must be checked on an annual basis or what is specified by the manufacturer of the antifreeze. Antifreeze must be replaced every 3-5 years or what is specified by the manufacturer of the antifreeze.



WARNING

Do not use automotive, ethylene glycol or petroleum-based antifreeze. Do not use any undiluted antifreeze. This can cause substantial property damage, serious injury, or death.



WARNING

Water from opened drain valves, unions and other connections may be extremely hot. To avoid substantial property damage, serious injury, or death:

- **Tighten all drain hose connections.**
- **Direct hot water away from all persons.**

5.3.1 Preparation for Draining the Tank.

1. Turn off domestic operations on the boiler so that the boiler will not fire while draining the tank. Reference the boiler technical manual for more information.
2. Stop the pump on the boiler water side of the tank.

5.3.2 Draining Tank (Domestic Water) .



WARNING

Domestic water may be very hot. Hot domestic water can cause substantial property damage or serious injury.

1. Open fully the hot water faucet at a plumbing fixture in the building until cool water is coming out of the hot water faucet.

BEST PRACTICE

Opening multiple hot water faucets will speed up the process.

2. Close the DHW cold water valve and allow water flow to stop.
3. Close the DHW cold and hot valves.
4. Ensure that the DHW side of the tank is open to atmosphere so as to not create a vacuum.
5. Check that the drain valve is piped (hose) to a correct place for disposal.
6. Open drain valve.
7. Once water has stopped flowing from the hose, no more water can be removed from the tank.
8. Close the drain valve and the hot water faucet after having drained the DHW tank.

5.3.3 Draining Coil (Boiler Water) .

1. Isolate the boiler circuit by closing the shutoff valves
2. Connect the drain valve to the sewer using a flexible hose.
3. Open the drain valve and drain the water from the coil to the drain.
4. Close the drain valve after draining the coil.

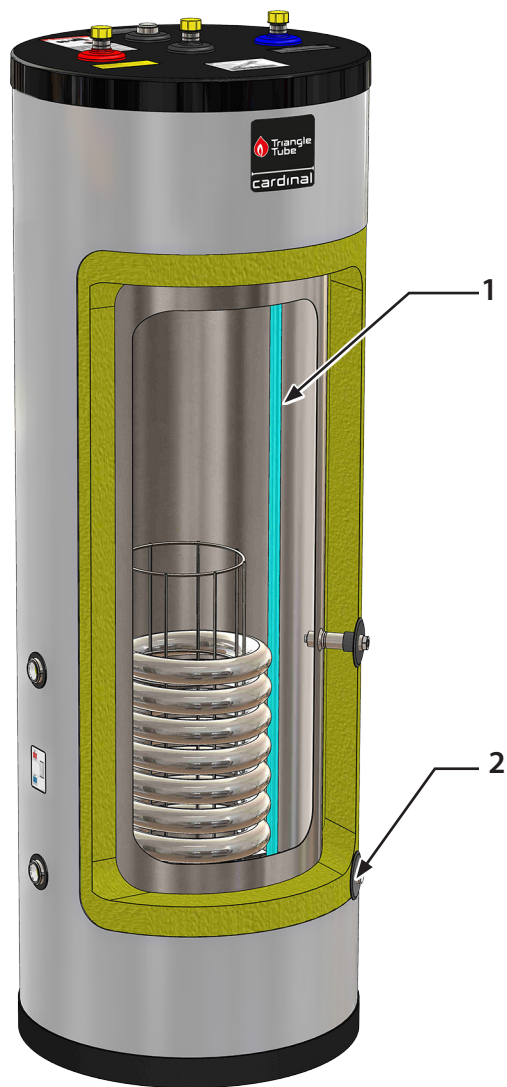


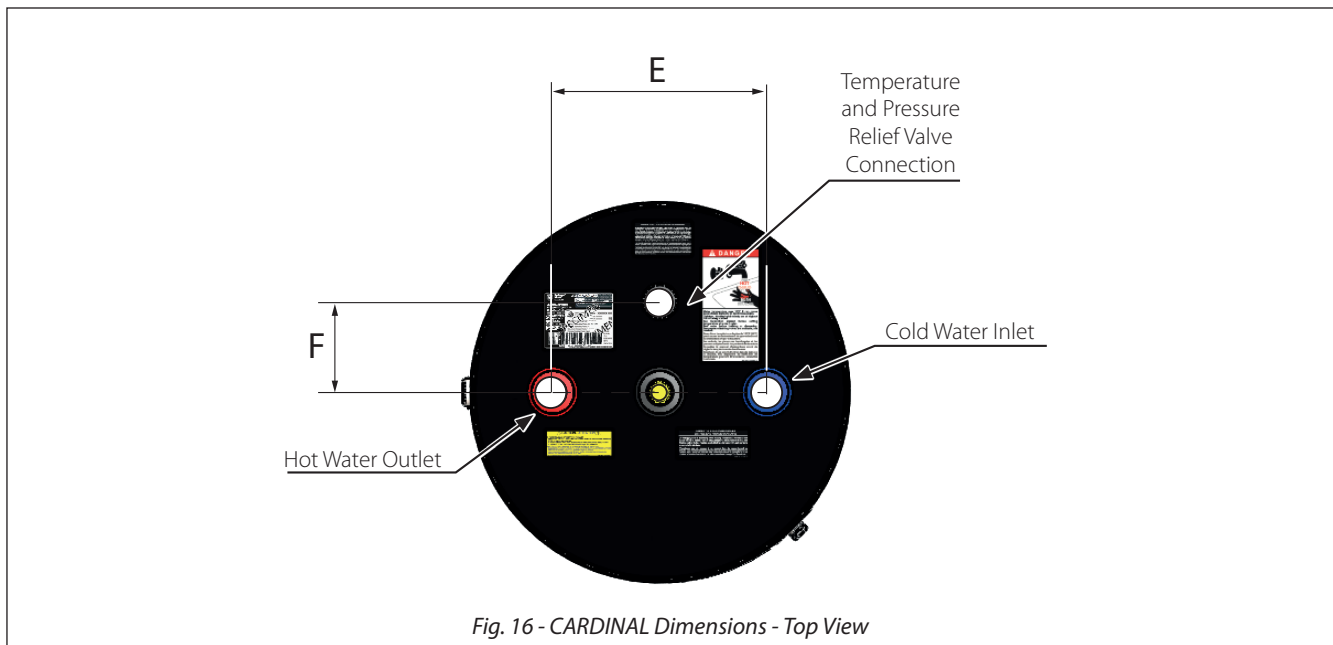
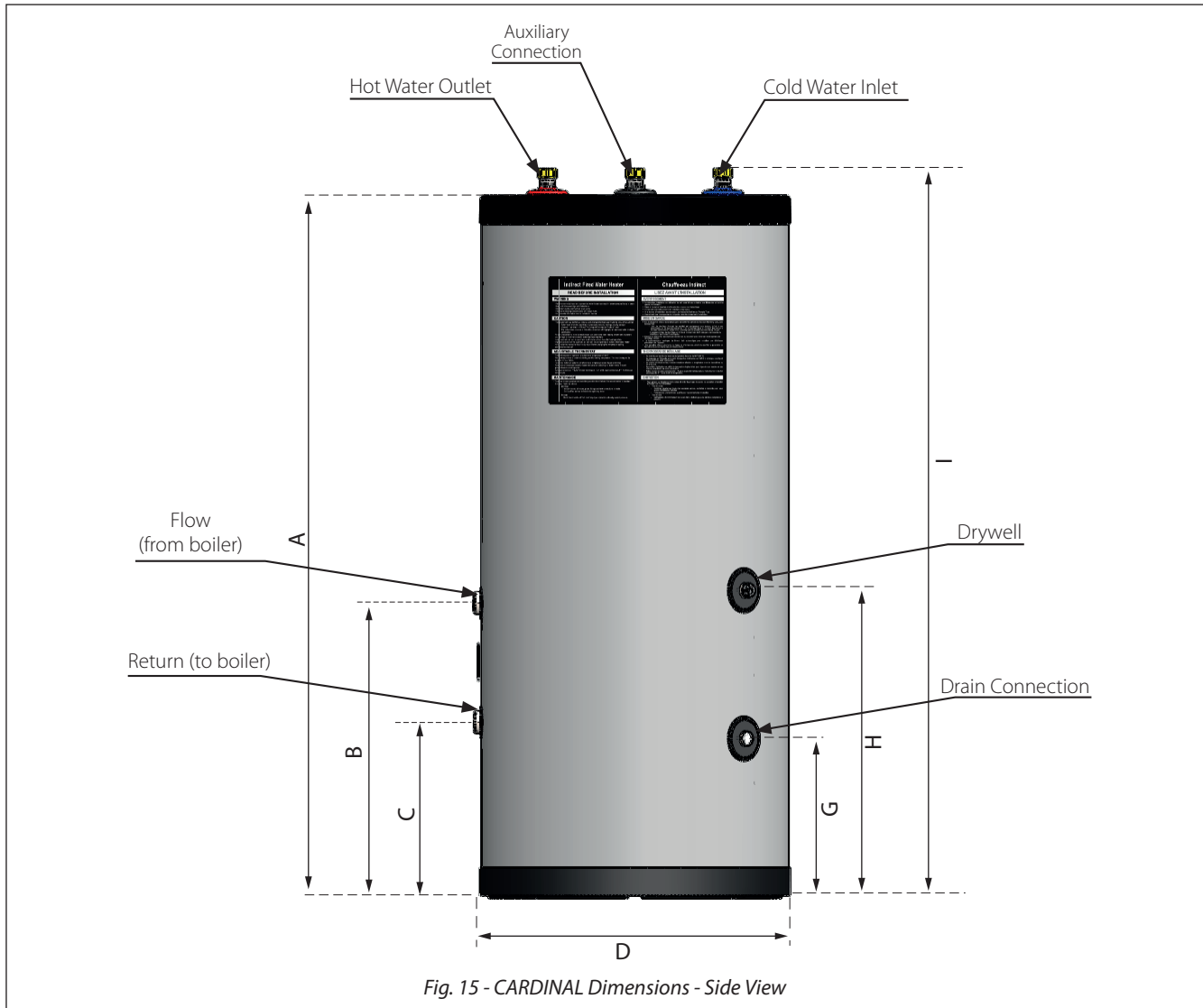
Fig. 14 - CARDINAL Assembly

CHAPTER 6 - REPLACEMENT PARTS

Item	Part #	Model	Description
1	CTRKIT300	CARDINAL 30	Dip Tube 30
	CTRKIT301	CARDINAL 40	Dip Tube 40
	CTRKIT302	CARDINAL 50	Dip Tube 50
	CTRKIT303	CARDINAL 60	Dip Tube 60
	CTRKIT304	CARDINAL 80 and 120	Dip Tube 80 and 120
	CTRKIT305	CARDINAL 100	Dip Tube 100
2	CTRKIT307	CARDINAL 30 to 120	Drain 1/2"
Not shown	SMRKIT203	CARDINAL 60 to 120	T&P Relief valve commercial
Not shown	SMRKIT204	CARDINAL 30 to 50	T&P Relief valve residential
Not shown	CTRKIT08	CARDINAL 30 to 120	Drywell

6.1. Accessories

Item	Part #	Model	Description
Not shown	CTRKIT09	CARDINAL 30 to 120	Aquastat



CHAPTER 7 - WATER HEATER SPECIFICATIONS AND PERFORMANCES

Table 5 - CARDINAL Water Heater Specifications


		CARDINAL						
Model		30	40	50	60	80	100	120
Capacity	Gal.							
Domestic		31	40	46.3	53.2	78.9	96.4	118.9
Boiler (coil)		1.3	1.3	1.5	1.5	2	2	3
Heating Surface	Sq. Ft.	8 1/2	8 1/2	12	12	16	16	21 1/2
Head Loss Boiler Side (flow rate : 14 GPM)	Ft. w.c.	2.3	2.3	3.4	3.4	5.3	5.3	7.6
Piping Connections	Inches							
Boiler (NPT) - [F]	Ø	1	1	1	1	1	1	1
Domestic (NPT) - [M]	Ø	3/4	3/4	3/4	3/4	1	1	1
Auxiliary (NPT) - [M]	Ø	3/4	3/4	3/4	3/4	1	1	1
T&P (NPT) - [F]	Ø	3/4	3/4	3/4	3/4	3/4	3/4	3/4
Drain (NPT) - [F]	Ø	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Drywell	Ø	1/2	1/2	1/2	1/2	1/2	1/2	1/2
Dimensions	Inches							
A		40 1/2	50 1/2	56 1/4	64	61	73	63 1/2
B		21 1/6	21 1/6	26	26	26 1/3	26 1/3	31 3/8
C		12 2/3	12 2/3	12 2/3	12 2/3	13	13	13 1/5
D		22 1/4	22 1/4	22 1/4	22 1/4	26 1/2	26 1/2	32 1/6
E		12 3/5	12 3/5	12 3/5	12 3/5	14 1/6	14 1/6	14 1/6
F		5 1/3	5 1/3	5 1/3	5 1/3	5 1/3	5 1/3	5 1/3
G		11 1/2	11 1/2	11 1/2	11 1/2	11 4/5	11 4/5	12
H		22	22	27	27	27 1/3	27 1/3	32 2/7
I		42 4/9	52 2/7	58 1/5	66	63 1/5	75	65 3/5
Dry well length (min length: 3 inches)	Inches	4	4	4	4	4	4	4
Empty weight	Lbs.	59	71	79	88	128	145	178

NOTICE

The values are available in metric units in the French section of this manual.

CHAPTER 7 - WATER HEATER SPECIFICATIONS AND PERFORMANCES

Table 6 - CARDINAL Indirect Water Heater Performance

Model	Potable Water Volume (Gallons)	Heat Source Volume (Gallons)	First Hour Rating (Gallons)					Minimum Heat Source Flow (GPM)	Minimum Heat Source Output (Btu/Hr.)
				Standby Loss (°F/Hr.)	First Draw (Gallons)	Continuous Draw (Gal./Hr.)	Heat Source Friction Loss (Feet W.C.)		
CARDINAL 30	31.2	1.3	214	1.0	25	189	2.3	14	120
CARDINAL 40	40.6	1.3	228	0.7	34	194	2.3	14	122
CARDINAL 50	46.3	1.6	281	0.8	39	242	3.4	14	154
CARDINAL 60	53.2	1.6	293	0.6	47	247	3.4	14	156
CARDINAL 80	78.9	2.1	372	0.5	70	302	5.3	14	192
CARDINAL 100	96.4	2.1	391	0.5	89	302	5.3	14	192
CARDINAL 120	118.9	3.0	505	0.3	101	189	7.6	14	257

Conditions:

- 58 °F [14.5 °C] Domestic cold water inlet temperature
- 135 °F [57 °C] Domestic hot water outlet temperature
- 180 °F [82 °C] Boiler water supply temperature

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- Specially designed built-in flow restrictor to assure maximum heat exchange
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- Available in 8 sizes to accommodate any size pool or spa

Prestige Condensing Boilers



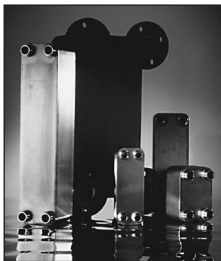
- 95% AFUE
- High Efficiency Condensing Boiler & Combi
- Power Range 80, 110, 155, 175, 250, 299, 399 MBH
- Turn Down Ratio up to 5:1
- Natural Gas or Propane
- Outdoor Reset

Instinct WHB & FSB Condensing Boilers



- 95% AFUE
- High Efficiency Condensing Boiler & Combi
- Power Range 110 MBH, 155 MBH, 199 MBH
- Turn Down Ratio up to 8:1
- Natural Gas or Propane
- Universal Top Adapter (PVC/PP/SST)
- Outdoor Reset

TTP Brazed Plate Heat Exchangers



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